SOLUTION

Instruction Manual

Preparation

To begin, a group of 2 to 6 people must be formed, and the materials from the following list should be available:

- Pencil or pen.
- A **Solution Board** sheet.
- A **Ideas Recording** sheet.
- A **Pugh Matrix** sheet.
- A **Blank Problem Template** sheet.
- Sheet of the **Contradiction Matrix**.
- Sheet of the **Feature Description**.
- Cards of the **40 Inventive Principles**.
- Cards of the **Separation Principles**.
- Cards of the **Resource Analysis**.
- Cards of **Predefined Problem**.

Game Mode

The group must use a **Blank Problem Template** to define a problem.

Objective

The objective is to solve the problem as a group, through cooperation and the exchange of ideas. Therefore, ideas must be generated to solve the problem in the best possible way.

To achieve this, the different phases of the game are listed below. These must be followed consecutively and all the way to the end with the help of the **Solution Board**.

Phase 1. Defining the problem.

”A problem is when a way of doing things does not meet the desired expectations.”.

Problems are abundant in our daily lives (work, personal life, etc.), and the solutions we come up with are generally not the most appropriate. For example

- A large table takes up a lot of space and doesn’t easily fit into just any area of our home. An immediate solution is to use a small table that fits into any space; however, the working surface area will also be reduced.
- Traveling in a vehicle at a moderate speed may result in not reaching our destination on time. An immediate solution is to increase the vehicle’s speed to travel faster; however, this makes the trip more unsafe.

In the previous examples, we can observe that our problems may have an immediate solution; however, that solution brings about another problem or even multiple problems.

Understanding the problem is very important, as generating a creative idea to solve it largely depends on that understanding.

If you need more help understanding this phase, review the cards of **Predefined Problem**, they are very detailed examples.

Assignment

The group must define a problem using a **Blank Problem Template**. Specifying the main advantages and disadvantages can help with its definition.

Phase 2. Defining the technical contradiction.

> *”When we improve something, and that improvement creates a problem for us, we are talking about a technical contradiction”.*

There are two types of contradictions: technical and physical. The *Technical Contradiction* must be defined first, as the *Physical Contradiction* will be defined based on it.

A simple way to define a *Technical Contradiction* is to do so using the following structure: "*If* this is done, *then* this improvement will be made, *but* this other thing will get worse". For example:

- If the size of the table is reduced, then it will easily fit into any place in our home, but its working area will decrease.
  - Feature that improves: Adaptability
  - Feature that worsens: Area of stationary object
- If the car’s speed is increased, then the destination can be reached faster, but the trip will become less safe.
  - Feature that improves: Loss of Time
  - Feature that worsens: Reliability

In the two example technical contradictions, there is something that improves and something that worsens. In the first technical contradiction, the table improves by becoming more adaptable, but its area worsens. In the second technical contradiction, our improvement is regarding the

waste of time, but reliability worsens. These things that improve and worsen are known as *Features*, which in turn must be identified.

Defining our problem in terms of contradictions helps us reason about it more deeply and generate a solution that solves the problem at its root. Contradictions are actually the problem!.

If you need more help understanding this phase, review the cards of **Predefined Problem**, they are very detailed examples.

Assignment

Starting from the problem definition, the group must formulate the *Technical Contradiction* using the example structure (If..., then..., but...) in the **Blank Problem Template** sheet. The *Features* of this contradiction must also be identified with the help of the **Feature Description** sheet (Which parameter improves and which one worsens?).

Phase 3. Defining the physical contradiction.

”When the improvement we desire, which causes us a problem, has two opposing properties, we say it is a physical contradiction”.

After the *Technical Contradiction* has been defined, the *Physical Contradiction* should be identified by considering the two opposing properties involved in our improvement. For example:

- The table must be small to fit anywhere in the house, and it must be large to provide a more suitable workspace.
- The car must go fast to reach our destination on time, and it must go slow to make the trip safer.

In both example physical contradictions, there is something that possesses two opposing properties. In the first physical contradiction, the table must be both large and small at the same time. In the second physical contradiction, the car must move both fast and slow at the same time.

The *Physical Contradiction* lies hidden within a *Technical Contradiction*. This way of digging deeper into a problem can help us imagine the solution from a different perspective.

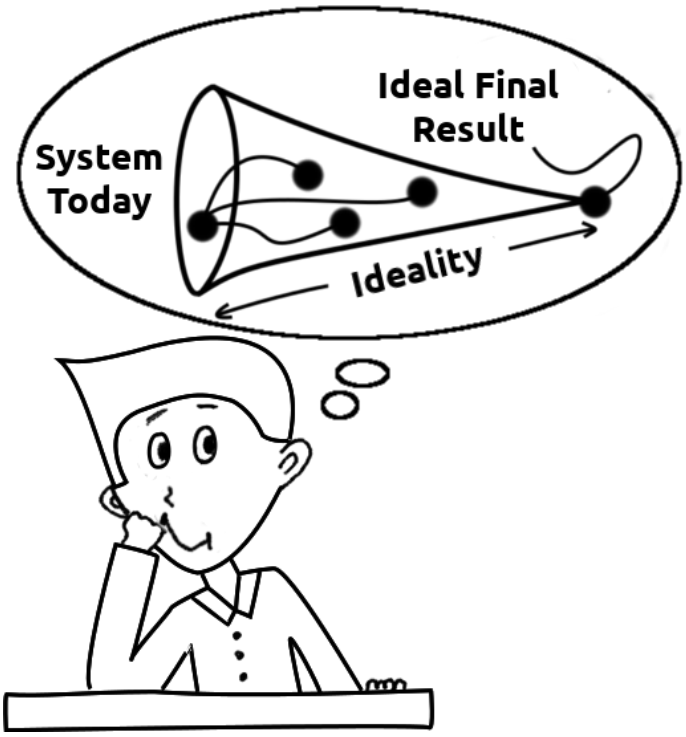
If you need more help understanding this phase, review the cards of **Predefined Problem**, they are very detailed examples.

Assignment

Starting from the *Technical Contradiction*, the group must formulate the *Physical Contradiction* in the **Blank Problem Template** sheet (How can something I want to use to improve a situation have two opposing properties?).

Phase 4. Defining the ideal final result.

”The ideal final result is the improvement that is made and that provides one or more benefits, without any kind of harm or cost”.



The *Ideal Final Result* should be thought of as a dream, something ephemeral that provides a solution to the problem (benefits) without generating any expense (cost) or contradiction (harm). For example:

- Create a table that adapts to any place in the house without losing its workspace area.
- Make the trip get us to our destination on time without making it more unsafe.

As seen in the previous examples, our *Ideal Final Result* contains no contradictions. This helps us envision what the perfect solution would look like, and in doing so, think about how we might get closer to achieving it.

If you need more help understanding this phase, review the cards of **Predefined Problem**, they are very detailed examples.

Assignment

The group must define the *Ideal Final Result* in the in the **Blank Problem Template** sheet, thinking about the improvement achieved without worsening anything else (What is the situation like without any contradiction?).

Phase 5. Solving the technical contradiction.

We can resolve the *Technical Contradiction* by using the **Contradiction Matrix** and the **40 Inventive Principles**.

”The 40 Inventive Principles are characteristics derived from the analysis of thousands of patents that were used for problem solving”.

”The Contradiction Matrix contains a set of known solutions based on the 40 Inventive Principles, which make it possible to overcome a technical contradiction”.

The Contradiction Matrix is two-dimensional. The rows represent the feature that improves, and the columns represent the feature that worsens. See Figure 1.

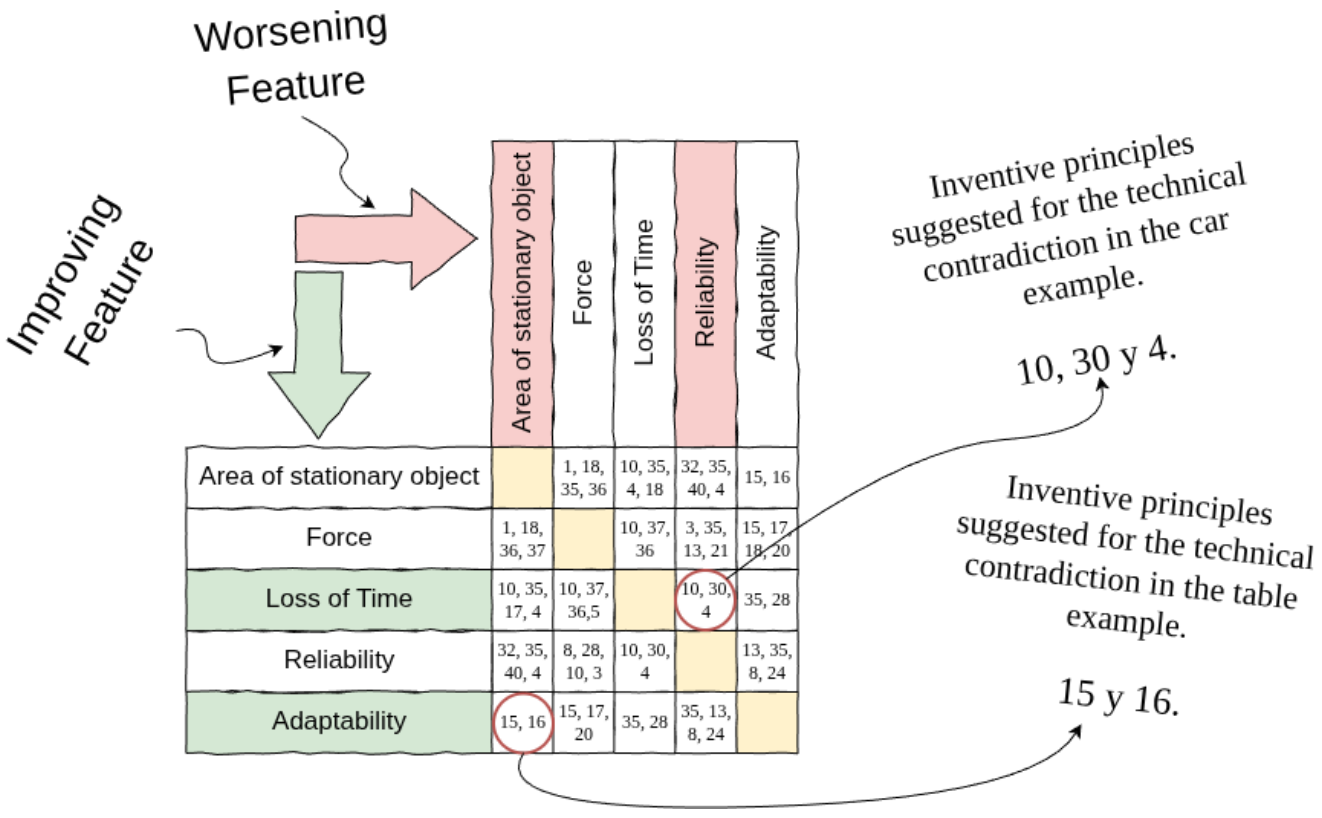


Figura 1: Dimensiones de la **Matriz de Contradicción** .

As shown in Figure 1, the **Contradiction Matrix** suggests which of the **40 Inventive Principles** to use according to the *Features* of our *Technical Contradiction*. For example:

- If the size of the table is reduced, then it can easily fit anywhere in our home, but its working area will decrease.
  - Principle 15 – Dynamic Parts. Make the table retractable or foldable.
  - Principle 16 – Partial or Excessive Actions. Create several small tables that can be joined as needed.
- If the speed of the car is increased, then it will be possible to reach a destination faster, but the trip will become less safe.
  - Principle 10 – Preliminary Action. Travel in advance.
  - Principle 30 – Flexible Shells and Thin Films. Allow a time buffer that can be compensated later.
  - Principle 4 – Asymmetry. Eliminate the need to travel by enabling all tasks to be done from home.

Assignment

At this phase, the **Contradiction Matrix** sheet and the cards of the **40 Inventive Principles** should be used.

When a *Technical Contradiction* is defined, it is also necessary to identify the *Features*, the one that improves and the one that worsens. These parameters must be located in the Contradiction Matrix, and at their intersection, the recommended Inventive Principles will appear (if the cell is empty, any of the principles may be used). The use of the Contradiction Matrix is optional, and the Inventive Principles can be applied freely.

The group must generate ideas based on the Inventive Principles (each card contains helpful information).

The ideas must be recorded on the **Ideas Recording** sheet.

Phase 6. Solving the physical contradiction.

The **Separation Principles** are used to resolve the *Physical Contradiction*.

”The Separation Principles were proposed as a mechanism to resolve physical contradictions by helping to separate the opposing states of an intended improvement that is also causing a problem”.

In turn, the **40 Inventive Principles** can be related to some of the **Separation Principles** and may be used as support, although not in a strict manner. For example:

- The table must be small to fit anywhere in the house, and it must be large to provide a more suitable workspace.
  - Separation in Time. A retractable or segmented table can serve different functions at different times.
- The car must go fast to reach our destination on time, and it must go slow to make the trip safer.
  - Separation on Condition. Shopping, chores, and work can be done from home without the need to travel elsewhere.

Assignment

At this phase, the **Separation Principles** cards should be used, and optionally the **40 Inventive Principles** cards.

The group must generate ideas aimed at resolving the *Physical Contradiction* using the Separation Principles (each card contains helpful information).

The ideas must be recorded on the **Ideas Recording** sheet.

Phase 7. Approaching the ideal final result.

”Resources are any type of substances that surround our problem and can be used”.

Resource Analysis are useful for solving problems without generating any cost. When we refer to resources, we think of those that are idle or free. For example:

- Making a table that fits anywhere in the house without losing its working area.
  - Space. Use the space or area under the table.
- Making the trip allow us to arrive at our destination on time without making it less safe.
  - Time. Optimize and take advantage of idle time before starting a trip to travel in advance.

The best solutions do not add costs and use already available resources to increase *Ideality*, which in turn brings us closer to the *Ideal Final Result*.

$$\text{Ideality} = \frac{\sum \text{Benefits}}{\sum \text{Cost} + \sum \text{Harm}}$$

Assignment

At this phase, the **Resources** cards should be used. The group must generate ideas aiming to reach the *Ideal Final Result* by analyzing the resources surrounding the problem (each card contains helpful information).

The ideas must be recorded on the **Ideas Recording** sheet.

Phase 8. Getting the best idea.

An inventive solution must always meet two requirements:

1. Improve a single part;
2. Without harming other parts.

”The Pugh Matrix is an ideal method to assist in selecting multiple ideas by comparing them against each other and with respect to a baseline”.

Assignment

The group should use the **Pugh Matrix** to evaluate all ideas according to the criteria found in that matrix (this matrix is not part of TRIZ, but it helps us evaluate ideas to find the most optimal one). For example:

- The first criterion is Effectiveness (Does this idea largely achieve the desired result?). If the idea is more effective than the current situation, it is assigned +1. If it is worse, it is assigned -1. If it is equally effective as the current situation, it is assigned 0.

At the end, the net score of each idea must be calculated. To do this, the arithmetic operation of the criteria scores for that idea is performed. Finally, the ranking of the ideas must be recorded, with number 1 assigned to the highest score, and therefore, this will be the best idea and maybe the Solution.